

# Kuipers & Associates

Sarah Zuzulock, PE

Senior Environmental Engineer PO Box 1859  
[szuzulock@kuipersassoc.com](mailto:szuzulock@kuipersassoc.com) Bozeman, MT 59771

Phone: (406)585-9932  
Fax: (406)585-9889

*Kuipers & Associates, LLC*

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Date: September 1, 2009

To: Anaconda Deer Lodge County

From: Kuipers & Associates

Subject: **Ambient Air Quality Monitoring  
Opportunity and Warm Springs Sites  
July 2009 Monthly Report**

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This July 2009 report documents the ambient air quality monitoring program conducted by Kuipers & Associates on behalf of Anaconda Deer Lodge County at the Opportunity and Warm Springs locations adjacent to the Atlantic Richfield Lower Waste Management Area (LWMA). Total Suspended Particulate (TSP) is monitored at Opportunity, and PM10 at Warm Springs. Additionally, wind speed, wind direction, temperature and relative humidity are monitored at both sites.

Dustfall jars have been in place since October 17, 2008 at both sites to capture settling dust. Preliminary results for samples collected between January 6 and June 1, 2009 can be summarized as follows. For the four samples collected at Opportunity, the calculated arsenic concentrations ranged from 122 mg/kg to 268 mg/kg, and the calculated lead concentrations ranged from 31.7 mg/kg to 154 mg/kg. For the two samples collected at Warm Springs, the preliminary calculated arsenic concentrations were 83.3 mg/kg and 140 mg/kg and the calculated lead concentrations were approximately 49.7 mg/kg and 88.1 mg/kg. These results are of similar magnitude to those for previous settled dust samples that were collected using glass dishes. Detailed results are attached to the end of this report.

Additionally, glass pie pans have been in place since August 15, 2008 at both sites to capture settling dust. The dust is being collected onto filters using a personal sampling pump, in conjunction with twice-weekly site visits. Two more sets of samples were collected between March 2 and July 10, 2009. At Opportunity, the preliminary calculated arsenic concentrations were 162 mg/kg and 153 mg/kg, and the lead concentrations were approximately 144 mg/kg and 125 mg/kg. This is consistent with previous settled dust analyses. At Warm Springs, the concentrations were 74.7 mg/kg and 29.5 mg/kg for arsenic, and 129 mg/kg and 92.6 mg/kg for lead. Final results will be attached to the monthly report for September 2009.

All data, discussion and conclusions provided in this report are preliminary and will undergo a complete quality assurance review prior to issuance of final results in quarterly and annual reports in accordance with the project Sampling and Analysis Plan. Results for the month are summarized as follows:

- Hourly average data were collected continuously by the monitors from July 1<sup>st</sup> through July 31<sup>st</sup>, with 99.6% availability for TSP at the Opportunity location and 89.4.6% availability for PM10 at the Warm Springs location.
  - Downtime at the Opportunity location occurred on July 10 from 14:00 MST through 15:00 MST for routine maintenance. Additional downtime occurred on July 3 at 12:00 MST due to a power outage.
  - Downtime at the Warm Springs location occurred on July 10 from 11:00 MST through 13:00 MST for routine maintenance. Additional downtime occurred from July 12 at 12:00 MST through July 15 at 15:00 MST because of an AC power supply failure.
- The hourly average data record for the month is attached to the end of this report. Current data is available for real-time electronic download on demand, and public viewing at: <http://ka.airsis.com/vision/login.aspx?ReturnUrl=%2fvision%2fDefault.aspx> (Username = ADLC, Password = OCPA).
- Monthly and quarterly air monitoring reports from June 2007 through present are now available on the County's website at: [http://anacondadeerlodge.mt.gov/super/info.aspx#q\\_reports](http://anacondadeerlodge.mt.gov/super/info.aspx#q_reports).
- At the Opportunity location the maximum TSP reading for the period on a daily average basis was 116  $\mu\text{g}/\text{m}^3$ , and the average monthly concentration was 28  $\mu\text{g}/\text{m}^3$ . The maximum reading for the period on an hourly average basis was 610  $\mu\text{g}/\text{m}^3$ . This value was associated with light northeast winds, indicating that the Lower Waste Management Area (LWMA) may have been a contributing source. The four highest daily and hourly maximum values are summarized in Table 1, and the average daily data for the month is attached together with meteorological information in Table 3.
- At the Warm Springs location the maximum PM10 reading for the period on a daily average basis was 20  $\mu\text{g}/\text{m}^3$ , and the average monthly concentration was 10  $\mu\text{g}/\text{m}^3$ . The maximum reading for the period on an hourly average basis was 136  $\mu\text{g}/\text{m}^3$ . This value was associated with light northwest winds. The four highest daily and hourly maximum values are summarized in Table 2, and the average daily data for the month is attached together with meteorological information in Table 4.

**Table 1**  
**Opportunity Site TSP Maximum Data, July 2009**

Maximum	TSP ( $\mu\text{g}/\text{m}^3$ )	Date & Time (MST)	Wind Speed (mph)	Wind Direction (deg)
Daily 1st Max	116	7/20/2009	3.6	11
Daily 2nd Max	65	7/23/2009	4.2	186
Daily 3rd Max	46	7/24/2009	4.2	356
Daily 4th Max	42	7/21/2009	3.4	345
Hourly 1st Max	610	7/20/2009 10:00	2.9	38
Hourly 2nd Max	488	7/20/2009 17:00	6.0	26
Hourly 3rd Max	464	7/23/2009 19:00	5.4	227
Hourly 4th Max	257	7/24/2009 15:00	12.5	NO DATA

**Table 2**  
**Warm Springs Site PM10 Maximum Data, July 2009**

Maximum	PM10 ( $\mu\text{g}/\text{m}^3$ )	Date & Time (MST)	Wind Speed (mph)	Wind Direction (deg)
Daily 1st Max	20	7/29/2009	2.7	353
Daily 2nd Max	13	7/23/2009	4.2	173
Daily 3rd Max	13	7/24/2009	3.3	55
Daily 4th Max	13	7/2/2009	2.6	333
Hourly 1st Max	136	7/29/2009 3:00	1.3	305
Hourly 2nd Max	110	7/29/2009 2:00	1.1	349
Hourly 3rd Max	54	7/20/2009 8:00	2.5	214
Hourly 4th Max	54	7/29/2009 4:00	1.1	1

- There are no Montana or Federal air quality standards for TSP; both were replaced by the current PM10 standard in 1987. Prior to 1987 the Montana annual TSP standard was  $75 \mu\text{g}/\text{m}^3$ , the 24-hour standard was  $200 \mu\text{g}/\text{m}^3$  and there was no hourly standard. TSP results for July at Opportunity were well below these historical standards. Monitoring for PM10 from May 2007 through June of 2008 showed that PM10 concentrations were consistently below regulatory levels. To facilitate comparison with previously collected PM10 data, the TSP data are being reported at Local temperature and pressure conditions.
- At the Warm Springs monitoring site daily average PM10 results for the month of July were well below the 24-hour Montana Ambient Air Quality Standard of  $150 \mu\text{g}/\text{m}^3$ . The average monthly concentration was below the annual PM10 standard of  $50 \mu\text{g}/\text{m}^3$ . There currently is no State or Federal standard for hourly PM10 data.
- Precipitation for the month was slightly below average at the Butte airport, but above average in Anaconda.
- Wind roses are attached to graphically depict prevailing winds.
  - Figure 1 shows the Opportunity location, where the predominant wind directions in July were from the southwest quadrant. Winds from the north and north-northeast also were common.
  - Figure 2 shows the Warm Springs location, where winds were mostly from northerly and southerly directions.
- If a dust storm event or nuisance dust in general is observed, please contact us so that we may respond, and try to quantify and document the problem. We are available seven days per week 24 hours per day and ask that you contact the following (in order) until someone is notified.

**Dust Event Contacts:**

Steve Heck	498-4199
David Dobrinien	490-9205
Jim Kuipers	782-3441, then 459-0445
Sarah Zuzulock	585-9932, then 581-1355

**Table 3**  
Opportunity Site Daily Average Data

Date	TSP Daily (µg/m <sup>3</sup> )	Wind Speed Daily (meters per second)	Wind Speed Daily (miles per hour)	Wind Direction Daily (degrees true)	Air Temperature Daily (Celsius)	Air Temperature Daily (Fahrenheit)	Relative Humidity Daily (percent)
July 1, 2009	33	1.7	3.7	358	17.3	63.1	47
July 2, 2009	38	1.4	3.1	326	16.7	62.0	62
July 3, 2009	31	1.3	2.9	171	17.6	63.7	59
July 4, 2009	29	1.8	4.0	181	18.3	65.0	51
July 5, 2009	23	1.9	4.3	198	18.4	65.2	54
July 6, 2009	32	2.1	4.6	139	17.0	62.7	63
July 7, 2009	20	2.0	4.5	295	13.4	56.2	63
July 8, 2009	6	1.6	3.5	224	9.9	49.8	74
July 9, 2009	10	1.8	4.0	304	11.2	52.1	63
July 10, 2009	13	1.5	3.4	167	14.9	58.7	53
July 11, 2009	17	1.4	3.1	287	18.2	64.7	49
July 12, 2009	19	1.8	4.0	195	17.6	63.6	62
July 13, 2009	12	2.9	6.5	276	14.2	57.6	66
July 14, 2009	11	1.7	3.8	299	13.7	56.7	70
July 15, 2009	20	1.8	4.1	252	17.5	63.4	51
July 16, 2009	22	1.9	4.2	39	18.8	65.8	44
July 17, 2009	23	1.5	3.3	355	19.0	66.2	48
July 18, 2009	31	1.5	3.4	247	20.9	69.7	43
July 19, 2009	33	2.2	5.0	296	20.7	69.3	39
July 20, 2009	116	1.6	3.6	11	16.5	61.7	44
July 21, 2009	42	1.5	3.4	345	18.2	64.8	45
July 22, 2009	30	1.6	3.6	212	20.9	69.6	37
July 23, 2009	65	1.9	4.2	186	23.7	74.7	34
July 24, 2009	46	1.9	4.2	356	20.3	68.6	55
July 25, 2009	22	1.7	3.8	NO DATA	19.4	66.9	58
July 26, 2009	24	2.2	4.8	NO DATA	18.7	65.6	60
July 27, 2009	15	1.6	3.5	NO DATA	14.9	58.8	80
July 28, 2009	18	1.3	2.9	334	13.2	55.8	78
July 29, 2009	20	1.6	3.5	9	13.9	57.1	65
July 30, 2009	31	1.6	3.6	13	14.9	58.8	56
July 31, 2009	17	1.7	3.8	3	15.6	60.1	62

**Table 4**  
Warm Springs Site Daily Average Data

Date	PM10 Daily (µg/m <sup>3</sup> )	Wind Speed Daily (meters per second)	Wind Speed Daily (miles per hour)	Wind Direction Daily (degrees true)	Air Temperature Daily (Celsius)	Air Temperature Daily (Fahrenheit)	Relative Humidity Daily (percent)
July 1, 2009	11	1.2	2.7	348	16.9	62.4	52
July 2, 2009	13	1.2	2.6	333	16.9	62.4	63
July 3, 2009	9	1.5	3.3	155	18.2	64.8	59
July 4, 2009	7	2.0	4.4	179	18.8	65.9	49
July 5, 2009	9	2.0	4.4	186	18.6	65.4	55
July 6, 2009	8	1.6	3.5	159	17.1	62.8	63
July 7, 2009	9	1.7	3.9	211	14.1	57.4	63
July 8, 2009	6	1.7	3.8	221	10.7	51.2	73
July 9, 2009	4	1.6	3.6	256	12.0	53.6	62
July 10, 2009	6	1.4	3.0	168	14.9	58.9	54
July 11, 2009	8	1.3	3.0	291	18.5	65.3	49
July 12, 2009	13	1.2	2.6	209	16.6	61.8	60
July 13, 2009	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
July 14, 2009	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA	NO DATA
July 15, 2009	1	2.0	4.5	306	19.6	67.3	40
July 16, 2009	8	1.5	3.3	67	19.1	66.3	45
July 17, 2009	12	1.3	2.9	352	19.3	66.7	49
July 18, 2009	11	1.6	3.6	257	21.0	69.8	46
July 19, 2009	11	2.0	4.4	306	20.3	68.5	42
July 20, 2009	11	1.1	2.5	11	16.5	61.7	49
July 21, 2009	11	1.3	2.9	121	18.7	65.6	46
July 22, 2009	12	1.4	3.0	284	20.8	69.4	40
July 23, 2009	13	1.9	4.2	173	23.3	73.9	35
July 24, 2009	13	1.5	3.3	55	20.2	68.3	56
July 25, 2009	6	1.5	3.4	204	19.2	66.6	60
July 26, 2009	7	1.5	3.4	352	18.0	64.4	66
July 27, 2009	8	1.1	2.5	348	15.4	59.7	80
July 28, 2009	10	1.4	3.1	231	13.9	57.0	79
July 29, 2009	20	1.2	2.7	353	14.2	57.5	65
July 30, 2009	10	1.2	2.7	93	15.7	60.2	56
July 31, 2009	8	1.3	2.9	352	16.2	61.1	62

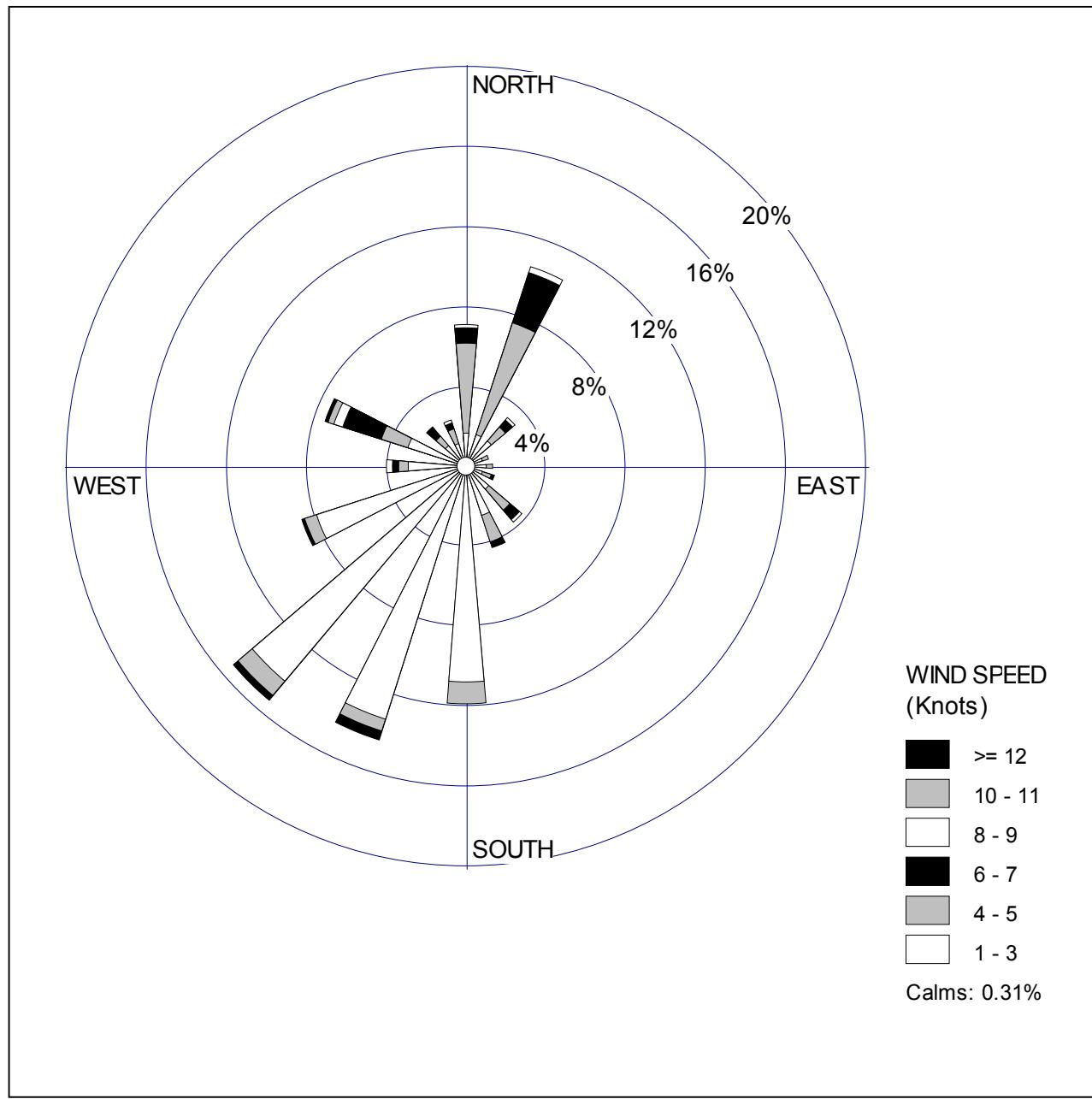
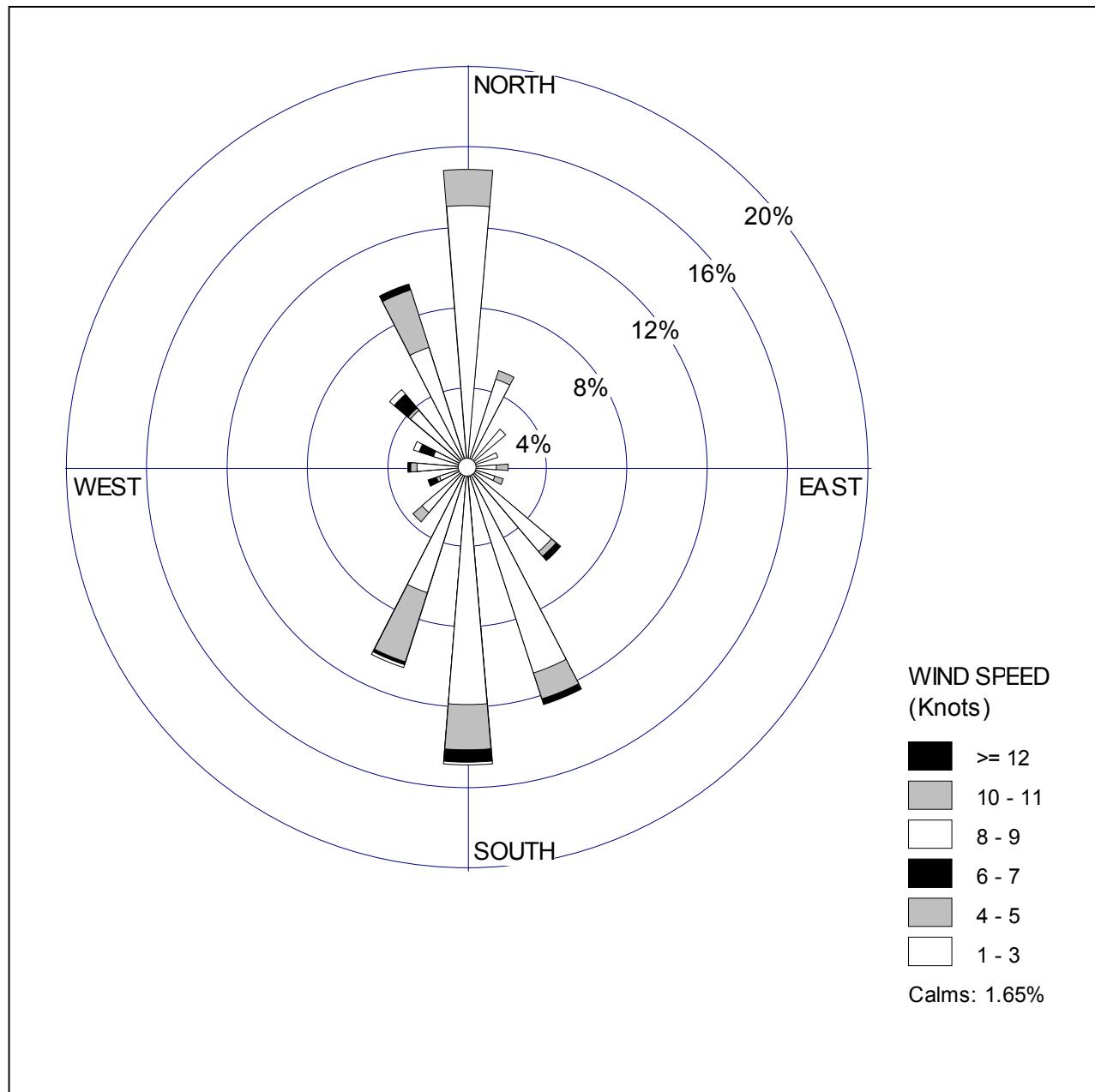


Figure 1. Wind Rose (percent of time blowing from indicated direction) for Opportunity EBAM Site July 2009.



**Figure 2. Wind Rose (percent of time blowing from indicated direction) for Warm Springs EBAM Site July 2009.**



**Blacktail Consulting, Inc.**  
Air Quality / Meteorology / Data Quality

P.O. Box 4692  
Butte MT 59702  
USA

Ph (406) 498-4199  
[sheck@rfwave.net](mailto:sheck@rfwave.net)

**MEMORANDUM – Opportunity / Warm Springs Dustfall Sampling Event**  
**January 6, 2009 through March 2, 2009 – Rev 1**

**Submitted by Steve Heck, Blacktail Consulting, Inc.**

**September 1, 2009**

*This memorandum describes the preliminary results of initial dustfall sampling conducted at the Opportunity and Warm Springs air monitoring sites on behalf of Kuipers and Associates, and Anaconda-Deer Lodge County. All data, discussion and conclusions provided in this report are preliminary and will undergo a complete quality assurance review prior to issuance of final results in quarterly and annual reports in accordance with the project Sampling and Analysis Plan. Analytical method development has continued, due to issues with isopropyl alcohol contamination described herein.*

### **1. Sample Collection**

On January 6, 2009, clean 6.75 inch diameter by 8.75 inch tall Nalgene, polypropylene dustfall jars were installed at both sites at a height of approximately 8 feet to capture and retain settling dust. The jars were de-contaminated by the laboratory prior to use by cleaning them with laboratory soap, then rinsing them with nitric acid and deionized water. The jars were initially filled to a depth of 4 inches with a 50/50 mixture of deionized water (DI H<sub>2</sub>O) and 99.5% pure, Amercian Chemical Society (ACS) grade isopropyl alcohol (propanol) to prevent freezing. Additionally, because of concerns with trace element contamination introduced by propanol, a second jar at the Opportunity site was filled with DI H<sub>2</sub>O only. The jars were inspected during twice-weekly site visits; DI H<sub>2</sub>O and/or propanol were added as necessary to maintain a liquid level of at least an inch. At the end of the sampling period on March 2, 2009, the jars were covered with clean lids, and transported to the MSE laboratory for analysis. A field blank was also prepared by partially filling a clean jar with DI H<sub>2</sub>O.



## **2. Analytical Procedures**

After delivery to the laboratory, the dustfall jar contents were transferred into 2,000 mL beakers, which then were covered with watchglasses and evaporated in a convection oven at a temperature of 90 to 105°C. After the liquid evaporated down to approximately 100-200 mL, the contents were transferred to pre-weighed 200-mL beakers and evaporated to dryness. The beakers then were weighed to within 0.0001 grams to determine a net particulate residue weight. The residue was digested using SW-846 Method 3050B for soils, and analyzed for trace metals by ICP Mass Spectrometer (ICP-MS) using Method SW-846 6020A.

## **3. Raw Analytical Results**

The raw analytical results – presented in Part A of Table 1 – show the trace element concentrations in the liquid as received by the laboratory, the volume of liquid initially evaporated, and the net weight of solids after evaporation. The influence of propanol on the analytical results is obvious, particularly for arsenic, and to a lesser extent copper and lead.

A 50-mL aliquot of propanol was obtained directly from its container, then evaporated and brought up to 50 mL for ICP-MS analysis. The results (Part A of Table 1) show significant trace element levels in the propanol, requiring a blank correction as discussed in Section 4.

The total trace element mass in each sample was calculated by multiplying the concentration in the sample liquid by the volume of liquid as received by the laboratory. Those results are shown in Part B of Table 1.

## **4. Trace Element Results with Blank Correction**

While the propanol's trace element concentrations are relatively low, they significantly affect the dustfall results because of the small amount of particulate (roughly 10 mg), and the large amount of propanol (9 liters) used in each dustfall bucket over the duration of the sampling period. To calculate the effect of these impurities on the submitted dustfall samples, one first must calculate the amounts of trace elements introduced to the samples. For example, a total of nine liters of propanol were added to each jar over the sample collection period (including initial setup); therefore, each sample collection jar contained 21.3 µg of arsenic and 117 µg of zinc.

Appropriate blank corrections must be made by subtracting the trace element mass contributions by the propanol. Results are shown in Part C of Table 1. Unfortunately, the net results for most trace elements were negative. This is likely due to uncertainty in the trace element concentrations within the propanol itself. In addition to the propanol analysis performed in conjunction with this sample submittal, an aliquot of propanol was analyzed for trace elements in the fall of 2008. There is some variance between the two sets of analytical results, as shown below:

Analyte	Current Propanol Screen ( $\mu\text{g/L}$ )	Previous Propanol Screen ( $\mu\text{g/L}$ )	Reporting Limit ( $\mu\text{g/L}$ )
As	2.31	1.60	3.00
Cd	0.381	ND	0.200
Cu	2.14	ND	2.50
Pb	0.516	ND	0.400
Zn	13.0	1.24	6.00

Although the two aliquots were obtained from different propanol bottles received several months apart, both were from the same manufacturer's lot number. In all cases, the differences between the two results were less than twice the analytes' reporting limits. However, even small differences in the assumed trace element levels have drastic effects on the calculated trace element concentrations in the dustfall particulate.

Arsenic is a good case in point. As discussed previously, when an arsenic (in propanol) concentration of 2.31  $\mu\text{g}$  is used for the blank correction, a net mass of -6.99  $\mu\text{g}$  is obtained for the Opportunity sample, and -1.00  $\mu\text{g}$  for the Warm Springs sample. However, using the arsenic concentration of 1.60  $\mu\text{g}$  obtained from the first analysis gives a result of -0.06  $\mu\text{g}$  for Opportunity and 5.93  $\mu\text{g}$  for Warm Springs. I.e., changing the assumed arsenic concentration in the propanol by only 0.71  $\mu\text{g/L}$  (less than one-fourth of the arsenic reporting limit) changes the calculated arsenic mass in the dustfall particulate by roughly 7  $\mu\text{g}$ .

Because of the trace element contamination issue, the use of propanol in dustfall jars was discontinued beginning with the samples started on March 2, 2009. The large amount of propanol (9 liters for the samples discussed herein) required to prevent freezing over the sampling period coupled with the small amount of particulate captured by the jars exacerbates any analytical uncertainties. Also, there is no assurance that the trace element concentrations from different propanol bottles – or even within a single bottle – are uniform.

## 5. Trace Element Concentrations in Dustfall Particulate

The trace element concentrations in the collected particulate were calculated by dividing the blank-corrected trace element weights by the total amount of particulate collected in each sample. Results are shown in Part D of Table 1. The results for the Opportunity sample in which **only** DI H<sub>2</sub>O was used (highlighted) were 214 mg/kg for arsenic, and 154 mg/kg for lead. These values are of the same magnitude as for previous glass dish dust samples, and for values calculated from ARCO's South sampler trace element results.

Because of problems introduced by trace elements in the propanol, meaningful results for the other two dustfall jars cannot be calculated.

## 6. Calculation of Total Dustfall Rate

Dustfall is normally expressed in units of g/m<sup>2</sup>/month, and is calculated by dividing the mass of particulate collected by the cross-sectional area of the dustfall jar, and dividing that result by the

number of days the sample was collected over. At Opportunity, the total particulate mass collected was 9.1 mg for the jar containing propanol, but only 4.4 mg for the jar containing only DI H<sub>2</sub>O. The discrepancy may be due to small amounts of residual particulate in the propanol bottles. However, it is also possible that the discrepancy reflects better particulate capture and retention in the jar containing propanol, since the jar containing only DI H<sub>2</sub>O was frozen much of the time. For the Warm Springs sample (which also contained propanol), the total particulate mass collected was 10.1 mg.

With a diameter of 6.75 inches, the dustfall jars have a cross-sectional area of 35.78 in<sup>2</sup>, or 0.0231 m<sup>2</sup>. The calculated dustfall rates were 0.39 g/m<sup>2</sup> and 0.19 g/m<sup>2</sup> for the Opportunity samples, and 0.44 g/m<sup>2</sup> for the Warm Springs sample. This equals 0.21 g/m<sup>2</sup>/month and 0.10 g/m<sup>2</sup>/month at Opportunity, and 0.24 g/m<sup>2</sup>/month at Warm Springs (based on a 30-day month). These values are very low when compared to the Montana settleable particulate standard of 10 g/m<sup>2</sup>/month. It should be noted the dustfall samples discussed herein are basically at or below the method's stated detection limit of 0.2 g/m<sup>2</sup>/month.

## **7. Data Quality Issues and Recommendations for Future Sampling and Analysis**

The new evaporation and weighing procedure (implemented in January 2009) provides much better mass resolution –less than one mg, versus as much as 0.02-0.03 g (20-30 mg) previously. However, the results presented herein show that the use of propanol introduces an unacceptable level of uncertainty into the trace element results, even when a blank correction is used. Therefore, propanol will not be used for subsequent samples.

Other brands/grades of propanol could be evaluated for improved purity, though the brand that was used is considered a high grade. However, initial investigation has not identified a propanol source that will guarantee sufficiently low (e.g., 0.1 µg/L or less) trace element concentrations. A couple of purportedly ultra-pure – and very costly – brands only specify trace element concentrations at 10 ppb or less. The use of propanol may be considered for the 2009-2010 winter season, if a source of proven quality can be identified.

The differences in net particulate mass for the two Opportunity samples suggests that freezing may affect the dustfall jars' particulate collection efficiency. However, part of the discrepancy could be due to residual particulate in the propanol bottles. Since each dustfall sample used a total of 9 liters of propanol, even a very small mass of particulate per bottle could have a large aggregate effect on the total mass.

The trace element results for the Opportunity dustfall sample collected using only DI H<sub>2</sub>O were comparable to results from previous glass dish dust sampling. However, the accompanying Field Blank (also prepared using only DI H<sub>2</sub>O) had a significant concentration of lead. At present it is not known whether the contamination arose during preparation and/or transport of the Field Blank, or during evaporation of the sample in the laboratory. An additional Field Blank sample was submitted with the dustfall samples collected during the period from April 5 – June 1, 2009 to confirm results.

**TABLE 1 -- SUMMARY OF OPPORTUNITY / WARM SPRINGS DUSTFALL RESULTS**  
**(Samples collected from 1-6-2009 to 3-2-2009)**

**A. Raw Analytical Results**

Analyte	Opportunity (w/propanol) (ug/L)	Opportunity (no propanol) (ug/L)	Warm Springs (w/propanol) (ug/L)	Propanol Blank (ug/L)	Field Blank (no propanol) (ug/L)
As	26.9	1.54	50.2	2.37	0.062
Cd	0.132	0.069	0.612	0.381	0.121
Cu	18.2	5.49	51.2	2.14	0.143
Pb	3.44	1.11	13.6	0.516	1.01
Zn	38.7	26.0	46.4	13.0	2.11
Sample Volume (mL)	533	611	405	50 mL	955
Solids Weight (mg)	9.1	4.4	10.1	N/A	1.4
Solids (mg/L)	17.1	7.2	24.9	N/A	1.5
ND = Not Detected; NA = Not Applicable					

**B. Total Trace Element Mass**

Analyte	Opportunity (w/propanol) (ug/L)	Opportunity (no propanol) (ug/L)	Warm Springs (w/propanol) (ug/L)	Field Blank (no propanol) (ug/L)
As	14.3	0.941	20.3	0.059
Cd	0.070	0.042	0.248	0.116
Cu	9.70	3.35	20.7	0.137
Pb	1.83	0.678	5.51	0.965
Zn	20.6	15.9	18.8	2.02
Volume of alcohol used for sample (L)	9.0	0.0	9.0	0.0

**C. Net Trace Element Mass** (with mass contribution from propanol subtracted)

Analyte	Opportunity (w/propanol) (ug)	Opportunity (no propanol) (ug)	Warm Springs (w/propanol) (ug)	Field Blank (no propanol) (ug)
As	-6.99	0.941	-1.00	0.059
Cd	-3.36	0.042	-3.18	0.116
Cu	-9.56	3.35	1.48	0.137
Pb	-2.81	0.678	0.86	0.965
Zn	-96.4	15.9	-98.2	2.02
Volume of alcohol used for sample (L)	9.0	0.0	9.0	0.0

**D. Trace Element Results** (trace element mass per particulate mass)

Analyte	Opportunity (no propanol) (mg/kg)	Reporting Limit (mg/kg)	Opportunity (w/propanol) (mg/kg)	Warm Springs (w/propanol) (mg/kg)
As	214	17.0	-768	-98.9
Cd	9.58	1.14	-369	-315
Cu	762	14.2	-1050	146
Pb	154	2.27	-309	85.5
Zn	3610	34.1	-10590	-9724



**Blacktail Consulting, Inc.**  
Air Quality / Meteorology / Data Quality

P.O. Box 4692  
Butte MT 59702  
USA

Ph (406) 498-4199  
[sheck@rfwave.net](mailto:sheck@rfwave.net)

## **MEMORANDUM – Opportunity / Warm Springs Dustfall Sampling Events – Rev 1**

**Sampling Periods: March 2 - April 5, 2009 and April 5 – June 1, 2009**

**Submitted by Steve Heck, Blacktail Consulting, Inc.**

**September 1, 2009**

*This memorandum describes the preliminary results of dustfall sampling conducted at the Opportunity and Warm Springs air monitoring sites on behalf of Kuipers and Associates, and Anaconda-Deer Lodge County. All data, discussion and conclusions provided in this report are preliminary and will undergo a complete quality assurance review prior to issuance of final results in quarterly and annual reports in accordance with the project Sampling and Analysis Plan. Analytical method development has continued, due to issues with isopropyl alcohol contamination described herein.*

### **1. Sample Collection**

On March 2, 2009, clean 6.75 inch diameter by 8.75 inch tall Nalgene, polypropylene dustfall jars were installed at both sites at a height of approximately 8 feet to capture and retain settling dust. The jars were de-contaminated by the laboratory prior to use by cleaning them with laboratory soap, then rinsing them with nitric acid and deionized water. The jars were initially filled to a depth of 2 inches with deionized water (DI H<sub>2</sub>O). The jars were inspected during twice-weekly site visits; DI H<sub>2</sub>O was added as necessary to maintain a liquid level of at least an inch. At the end of the sampling period on April 5, 2009, the jars were covered with clean lids, and transported to the MSE laboratory for analysis. A field blank was also prepared by partially filling a clean jar with DI H<sub>2</sub>O.



Another set of jars was installed on April 5, 2009 and retrieved on June 1, 2009. They were filled and maintained in an identical manner.

## **2. Analytical Procedures**

After delivery to the laboratory, the dustfall jar contents were transferred into 2,000 mL beakers, which then were covered with watchglasses and evaporated in a convection oven at a temperature of 90 to 105°C. After the liquid evaporated down to approximately 100-200 mL, the contents were transferred to pre-weighed 200-mL beakers and evaporated to dryness. The beakers then were weighed to within 0.0001 grams to determine a net particulate residue weight. The residue was digested using SW-846 Method 3050B for soils, and analyzed for trace metals by ICP Mass Spectrometer (ICP-MS) using Method SW-846 6020A.

## **3. Raw Analytical Results**

The raw analytical results are presented in Part A of Table 1 (for the first set of samples) and Table 2 (for the second set of samples). They show the trace element concentrations in the liquid as received by the laboratory, the volume of liquid initially evaporated, and the net weight of solids after evaporation.

The total trace element mass in each sample was calculated by multiplying the concentration in the sample liquid by the volume of liquid as received by the laboratory. Those results are shown in Part B of Tables 1 and 2.

## **4. Trace Element Concentrations in Dustfall Particulate**

The trace element concentrations in the collected particulate were calculated by dividing the trace element weights by the total amount of particulate collected in each sample. Results are shown in Part C of Tables 1 and 2. The results for these samples were of the same magnitude as for previous glass dish dust samples, and were similar to values previously calculated from ARCO's South sampler trace element results. However, a large variance was noted for the duplicate samples collected at Opportunity. This could be due to non-uniformity in the particulate, particularly during blowing dust episodes (although it can't be stated that such episodes occurred during the sampling period). Also, because the total amounts of particulate captured during the sampling period were quite small (5.4 mg and 3.5 mg for the duplicate samples), any other materials captured by the jars (such as windblown vegetation matter or insects) would have a significant impact.

Preliminary particulate concentrations for arsenic and lead can be summarized as follows:

<b>Sampling Period</b>	<b>Opportunity (mg/kg)</b>		<b>Warm Springs (mg/kg)</b>	
	As	Pb	As	Pb
3/2/2009 – 4/5/2009	122	31.7	140	49.7
3/2/2009 – 4/5/2009 (Duplicate)	268	107	N/A	N/A
4/5/2009 – 6/1/2009	148	101	83.3	88.1

## **5. Calculation of Total Dustfall Rate**

Dustfall is expressed in units of  $\text{g}/\text{m}^2/\text{month}$ , and is calculated by dividing the mass of particulate collected by the cross-sectional area of the dustfall jar, and dividing that result by the number of days the sample was collected over. With a diameter of 6.75 inches, the dustfall jars have a cross-sectional area of  $35.78 \text{ in}^2$ , or  $0.0231 \text{ m}^2$ . The calculated dustfall rates were as follows:

<b>Sampling Period</b>	<b>Opportunity</b>		<b>Warm Springs</b>	
	$\text{g}/\text{m}^2$	$\text{g}/\text{m}^2/\text{month}$ (1)	$\text{g}/\text{m}^2$	$\text{g}/\text{m}^2/\text{month}$ (1)
3/2/2009 – 4/5/2009	0.23	0.21	0.10	0.08
3/2/2009 – 4/5/2009 (Duplicate)	0.15	0.13	N/A	N/A
4/5/2009 – 6/1/2009	1.80	0.95	0.93	0.49

(1) Dustfall rate based on 30-day month.

The values for the first set of samples are basically at or below the method's stated detection limit of  $0.2 \text{ g}/\text{m}^2/\text{month}$ . While the mass of particulate for the second set of samples was much greater, the calculated dustfall rates were still very low compared to the Montana settleable particulate standard of  $10 \text{ g}/\text{m}^2/\text{month}$ .

## **6. Recommendations for Future Sampling and Analysis**

The new evaporation and weighing procedure (implemented in January 2009) provides much better mass resolution –less than one mg, versus as much as  $0.02\text{--}0.03 \text{ g}$  (20-30 mg) previously. Additionally, the use of isopropyl alcohol was discontinued beginning with the samples discussed herein, due to trace element contamination issues.

Although current sampling procedures are providing better results, a new concern has arisen. Since late spring, the jars have trapped numerous flying insects, which makes an accurate particulate weight determination virtually impossible. The next set of jars (installed from June 1 to July 10, 2009) was not analyzed for that reason. Trapping of insects will likely be an issue until the first killing frost arrives, typically in early September.

**TABLE 1 -- SUMMARY OF OPPORTUNITY / WARM SPRINGS DUSTFALL RESULTS**  
**(Samples collected from 3-2-2009 to 4-5-2009)**

**A. Analytical Results**

Analyte	Opportunity-A (ug/L)	Opportunity-B (ug/L)	Warm Springs (ug/L)
As	0.462	0.625	0.222
Cd	0.040	0.072	0.045
Cu	1.41	1.34	0.949
Pb	0.120	0.249	0.079
Zn	9.20	6.95	5.16
Sample Volume (mL)	1425	1498	1385
Solids Weight (mg)	5.4	3.5	2.2
Solids (mg/L)	3.8	2.3	1.6
ND = Not Detected; NA = Not Applicable			

**B. Trace Element Weight**

Analyte	Opportunity-A Total (ug)	Opportunity-B Total (ug)	Warm Springs Total (ug)
As	0.658	0.936	0.307
Cd	0.057	0.108	0.062
Cu	2.01	2.01	1.31
Pb	0.171	0.373	0.109
Zn	13.1	10.4	7.15

**C. Trace Element Concentrations in Particulate**

Analyte	Opportunity-A mg/kg	Reporting Limit mg/kg	Opportunity-B mg/kg	Reporting Limit mg/kg
As	122	13.9	268	21.4
Cd	10.6	0.926	30.8	1.43
Cu	372	11.6	574	17.9
Pb	31.7	1.85	107	2.86
Zn	2428	27.8	2975	42.9

Analyte	Warm Springs mg/kg	Reporting Limit mg/kg
As	140	34.1
Cd	28.3	2.3
Cu	597	28.4
Pb	49.7	4.5
Zn	3248	68.2

**TABLE 2 -- SUMMARY OF OPPORTUNITY / WARM SPRINGS DUSTFALL RESULTS**  
**(Samples collected from 4-5-2009 to 6-1-2009)**

**A. Analytical Results**

Analyte	Opportunity (ug/L)	Warm Springs (ug/L)	Field Blank (ug/L)
As	9.26	2.96	0.027
Cd	0.351	0.300	0.025
Cu	28.7	11.1	0.199
Pb	6.35	3.13	0.049
Zn	44.7	24.5	1.50
Sample Volume (mL)	662	605	896
Solids Weight (mg)	41.5	21.5	0.2
Solids (mg/L)	62.7	35.5	0.2
ND = Not Detected; NA = Not Applicable			

**B. Trace Element Weight**

Analyte	Opportunity Total (ug)	Warm Springs Total (ug)	Field Blank Total (ug)
As	6.13	1.79	0.024
Cd	0.232	0.182	0.022
Cu	19.0	6.72	0.178
Pb	4.20	1.89	0.044
Zn	29.6	14.8	1.34

**C. Trace Element Concentrations in Particulate**

Analyte	Opportunity mg/kg	Reporting Limit mg/kg	Warm Springs mg/kg	Reporting Limit mg/kg
As	148	1.81	83.3	3.49
Cd	5.60	0.120	8.44	0.233
Cu	458	1.51	312	2.91
Pb	101	0.241	88.1	0.465
Zn	713	3.61	689	6.98



















Date & Time Mountain Standard Time (data for hour ending)	TSP Hourly (µg/m3)	Wind Speed Hourly (meters per second)	Wind Speed Hourly (miles per hour)	Wind Direction Hourly (degrees true)	Air Temperature Hourly (Celsius)	Air Temperature Hourly (Fahrenheit)	Relative Humidity Hourly (percent)
7/31/2009 2:00	16	1.3	2.9	192	10.0	50.0	68
7/31/2009 3:00	16	1.7	3.8	177	10.0	50.0	67
7/31/2009 4:00	7	1.4	3.1	186	10.2	50.4	66
7/31/2009 5:00	14	1.8	4.0	101	10.6	51.1	68
7/31/2009 6:00	20	1.0	2.2	268	10.3	50.5	72
7/31/2009 7:00	16	0.8	1.8	254	11.5	52.7	72
7/31/2009 8:00	23	0.6	1.3	359	12.6	54.7	78
7/31/2009 9:00	13	1.3	2.9	4	13.8	56.8	75
7/31/2009 10:00	8	1.7	3.8	16	16.1	61.0	68
7/31/2009 11:00	0	2.6	5.8	18	16.5	61.7	64
7/31/2009 12:00	1	2.3	5.1	29	18.4	65.1	55
7/31/2009 13:00	17	2.4	5.4	15	19.8	67.6	51
7/31/2009 14:00	17	2.8	6.3	20	20.8	69.4	49
7/31/2009 15:00	15	2.8	6.3	17	21.6	70.9	46
7/31/2009 16:00	70	2.7	6.0	3	22.4	72.3	44
7/31/2009 17:00	15	3.0	6.7	10	22.8	73.0	42
7/31/2009 18:00	26	2.8	6.3	2	22.9	73.2	40
7/31/2009 19:00	9	2.1	4.7	352	22.5	72.5	40
7/31/2009 20:00	25	1.1	2.5	268	19.5	67.1	53
7/31/2009 21:00	35	0.9	2.0	268	15.1	59.2	69
7/31/2009 22:00	18	0.8	1.8	207	13.0	55.4	76
7/31/2009 23:00	25	0.8	1.8	223	13.2	55.8	73
8/1/2009 0:00	0	1.0	2.2	233	11.8	53.2	77

AM = Miscellaneous void

AV = Power outage

BA = Routine maintenance / repairs



















Date & Time Mountain Standard Time (data for hour ending)	PM10 Hourly (µg/m3)	Wind Speed Hourly (meters per second)	Wind Speed Hourly (miles per hour)	Wind Direction Hourly (degrees true)	Air Temperature Hourly (Celsius)	Air Temperature Hourly (Fahrenheit)	Relative Humidity Hourly (percent)
7/31/09 2:00	12	1.1	2.5	165	11.3	52.3	67
7/31/09 3:00	8	1.7	3.8	174	11.1	52.0	66
7/31/09 4:00	12	2.2	4.9	192	11.4	52.5	64
7/31/09 5:00	19	1	2.2	11	10.1	50.2	75
7/31/09 6:00	14	0.6	1.3	263	10.2	50.4	77
7/31/09 7:00	14	0.6	1.3	213	11.5	52.7	77
7/31/09 8:00	4	0.6	1.3	26	12.2	54.0	81
7/31/09 9:00	24	0.7	1.6	3	14.2	57.6	77
7/31/09 10:00	-2	1.1	2.5	24	16.0	60.8	71
7/31/09 11:00	1	1.4	3.1	6	17.2	63.0	62
7/31/09 12:00	12	1.4	3.1	5	19.1	66.4	53
7/31/09 13:00	9	1.8	4.0	354	20.5	68.9	49
7/31/09 14:00	7	1.7	3.8	2	21.4	70.5	47
7/31/09 15:00	5	1.7	3.8	7	22.5	72.5	44
7/31/09 16:00	0	1.9	4.3	356	23.1	73.6	42
7/31/09 17:00	2	1.8	4.0	353	23.4	74.1	40
7/31/09 18:00	12	1.3	2.9	359	23.5	74.3	37
7/31/09 19:00	-1	1.2	2.7	330	22.7	72.9	42
7/31/09 20:00	3	0.8	1.8	280	18.7	65.7	63
7/31/09 21:00	-5	1.1	2.5	221	14.8	58.6	74
7/31/09 22:00	2	1.2	2.7	159	15.0	59.0	71
7/31/09 23:00	13	1.3	2.9	148	13.3	55.9	76
8/1/09 0:00	4	1.4	3.1	174	13.1	55.6	76

AV = Power outage

BA = Routine maintenance / repairs